*Environ Health Perspect*
DOI: 10.1289/ehp.1409144



# Supplemental Material

# Use of a Cumulative Exposure Index to Estimate the Impact of Tap-Water Lead Concentration on Blood Lead Levels in 1- to 5-Year-Old Children (Montreal, Canada)

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**Table S2:** Association between cumulative water lead exposure index and blood lead levels, assuming different gastrointestinal absorption rates and different fraction of flushed (versus stagnant) water ingested by children.

**Table S3:**

**References**

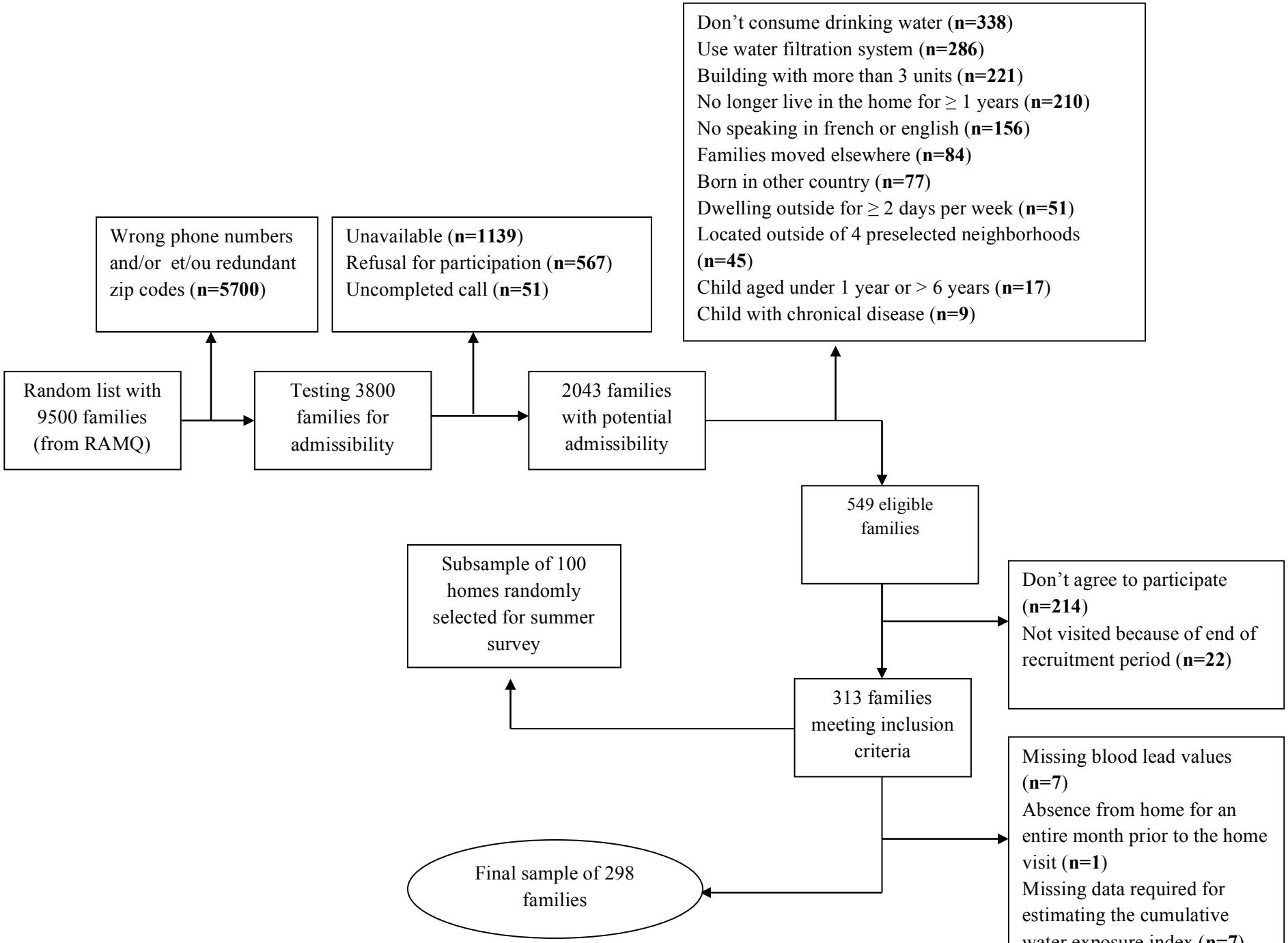


**Figure S1:** Selection process.

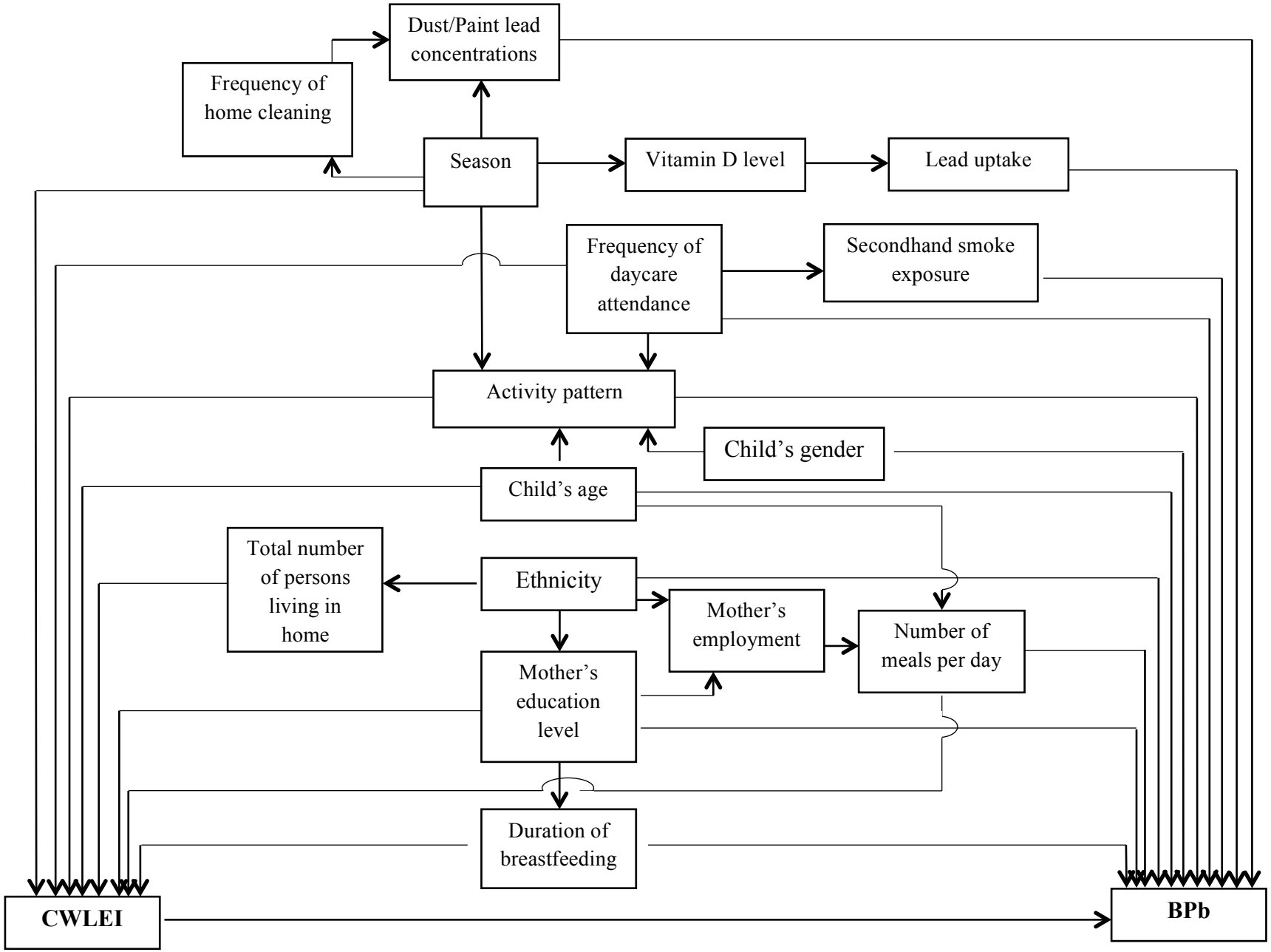


**Figure S2**: Initial causal diagram based on available variables.

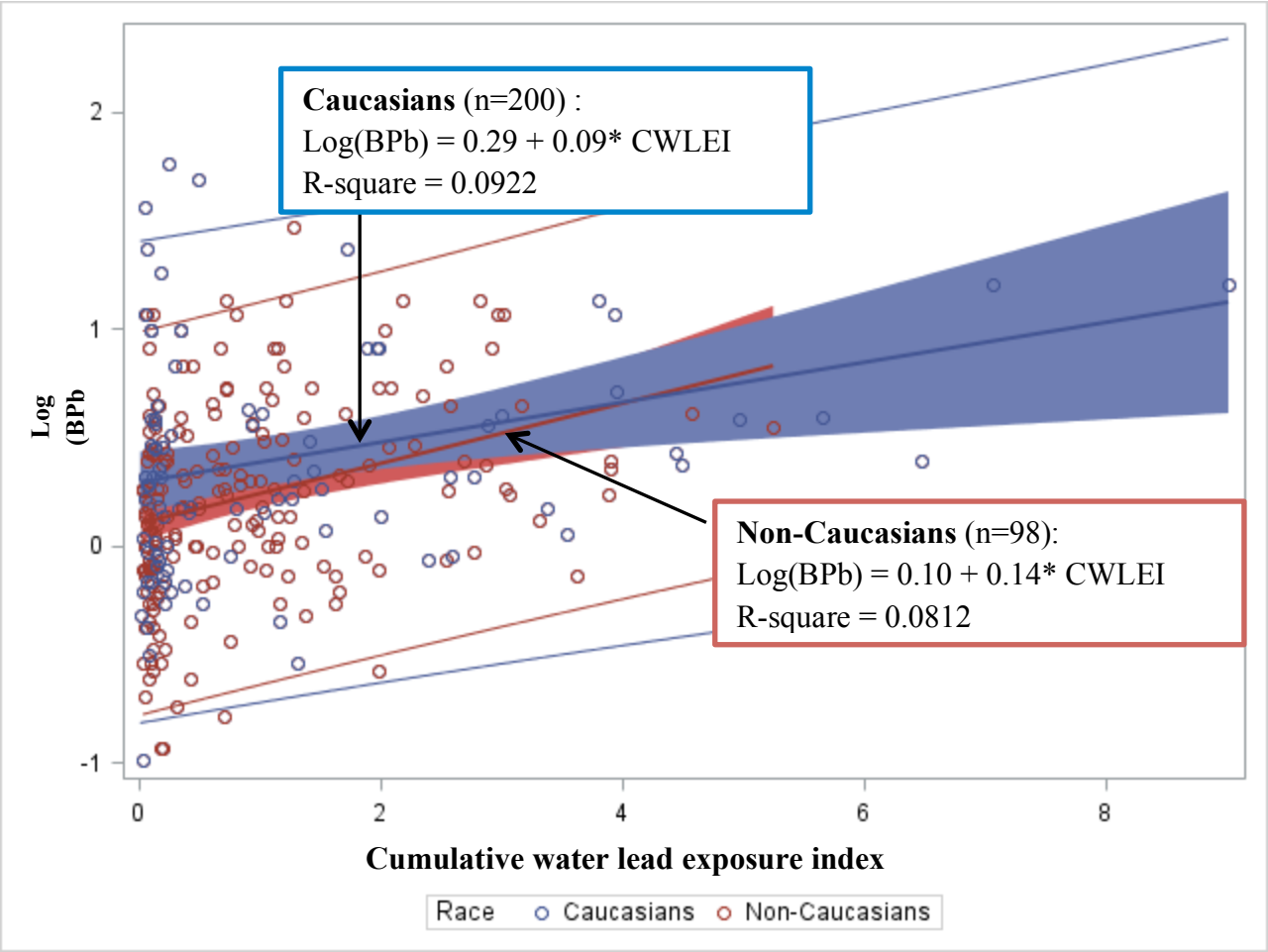


**Figure S3**: Scatter plot providing a crude estimation of Log(blood lead concentration) (in µg/dl) for cumulative water lead exposure index (in µg of Pb/kg of body weight) in Caucasians (blue circle) and Non-Caucasians children (red circle).

**Table S1:** Association between cumulative water lead exposure index and blood lead levels by assuming that children consume 100% of flushing or 100% of stagnant water.

| | **Cumulative water lead exposure index (in µg of Pb/kg of body weight)** | | **Ratio of mean blood lead concentration** | |
|---|---|---|---|---|
| | **Quartiles** | **Geometric mean within strata (95% CI)** | **Crude estimate (95% CI)** | **Adjusted estimate[c] (95% CI)** |
| **Flushing water[a]** | | | | |
| | < 0.12 (Ref) | 0.07 (0.01, 0.12) | 1 | 1 |
| | 0.12 – 0.48 | 0.22 (0.12, 0.48) | 1.06 (0.90, 1.24) | 0.94 (0.79, 1.13) |
| | 0.48 – 1.37 | 0.91 (0.47, 1.37) | 1.23 (1.05, 1.45) | 1.18 (0.98, 1.41) |
| | ≥ 1.37 | 2.57 (1.38, 8.75) | 1.49 (1.27, 1.75) | 1.37 (1.13, 1.66) |
| | | | $P_{Trend}$ *<0.0001* | $P_{Trend}$ *< 0.0001* |
| | | | *R-square = 0.1033* | |
| **Stagnant water[b]** | | | | |
| | < 0.27 (Ref) | 0.16 (0.07, 0.34) | 1 | 1 |
| | 0.27 – 0.78 | 0.42 (0.23, 0.78) | 1.06 (0.90, 1.24) | 0.94 (0.80, 1.13) |
| | 0.78 – 2.06 | 1.39 (0.82, 2.37) | 1.19 (1.01, 1.40) | 1.17 (0.98, 1.40) |
| | ≥ 2.06 | 3.81 (1.75, 8.29) | 1.46 (1.24, 1.72) | 1.38 (1.15, 1.66) |
| | | | $P_{Trend}$ *<0.0001* | $P_{Trend}$ *< 0.0001* |
| | | | *R-square = 0.1031* | |

'Ref' stands for 'Reference group'; [a] refers to the first 1-L sampled after 5 minutes of flushing; [b] refers to the arithmetic mean of the four consecutive 1-L sampled after a stagnation time of 30 minutes; [c] Adjusted for child's age, child's gender, child's ethnicity, duration of breastfeeding, mother's education level, frequency of daycare attendance, number of meals per day and the season of blood collection.

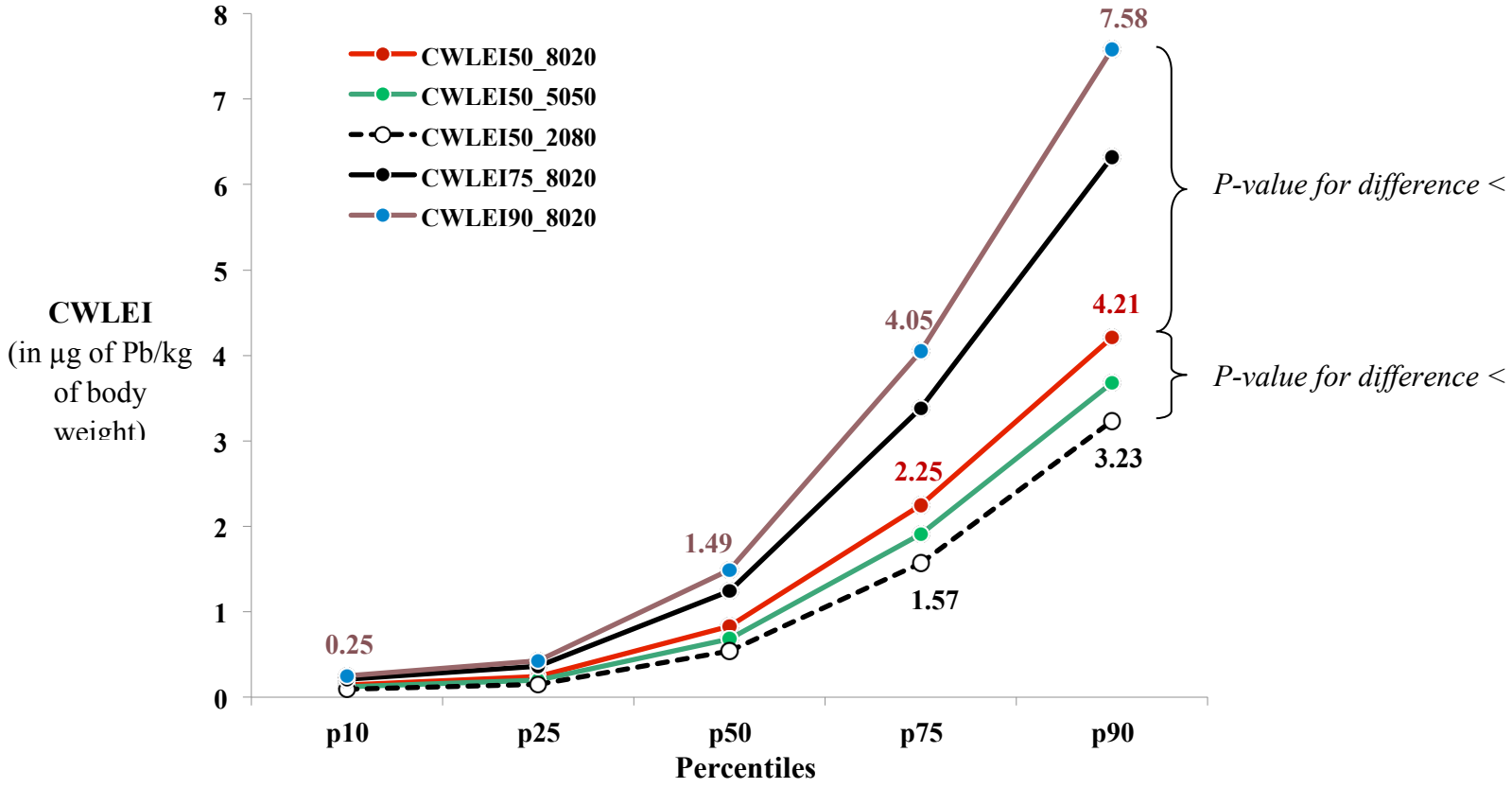


**Figure S4**: Influence of changes in both gastrointestinal absorption rate and fraction of flushed (versus stagnant) water ingested on the distribution of cumulative water lead exposure index (CWLEI). CWLEI50_8020 assumes a gastrointestinal absorption rate of 50% and that children consume 80% of stagnant water and 20% of flushed water.

**Table S2:** Association between cumulative water lead exposure index and blood lead levels, assuming different gastrointestinal absorption rates and differents fraction of flushed (versus stagnant) water ingested by children.

| | **Adjusted[a] ratio of mean blood lead concentration(95% Confident intervals)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Gastrointestinal absorption rate of 50% | | | Gastrointestinal absorption rate of 75% | | | Gastrointestinal absorption rate of 90% | | |
| Pctles[b] | **80:20[c]** | **50:50** | **20:80** | **80:20** | **50:50** | **20:80** | **80:20** | **50:50** | **20:80** |
| < p10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| p10 – p25 | 1.04(0.80, 1.34) | 0.99(0.76, 1.28) | 0.99(0.76, 1.30) | 1.04(0.80, 1.34) | 1.08(0.83, 1.42) | 1.00(0.77, 1.29) | 1.07(0.83, 1.39) | 1.00(0.77, 1.29) | 0.99(0.77, 1.29) |
| p25 – p50 | 0.96(0.76, 1.22) | 0.94(0.73, 1.19) | 0.94(0.74, 1.20) | 0.96(0.76, 1.22) | 0.98(0.76, 1.25) | 0.94(0.74, 1.19) | 0.98(0.77, 1.25) | 0.93(0.73, 1.19) | 0.94(0.73, 1.20) |
| p50 – p75 | 1.15(0.90, 1.46) | 1.19(0.90, 1.52) | 1.18(0.92, 1.51) | 1.18(0.93, 1.50) | 1.25(0.97, 1.60) | 1.18(0.93, 1.49) | 1.18(0.92, 1.51) | 1.19(0.93, 1.51) | 1.18(0.92, 1.51) |
| p75 – p90 | 1.44(1.11, 1.87) | 1.26(0.93, 1.64) | 1.28(0.97, 1.67) | 1.39(1.07, 1.82) | 1.34(1.02, 1.76) | 1.27(0.98, 1.65) | 1.48(1.13, 1.93) | 1.26(0.97, 1.64) | 1.28(0.97, 1.67) |
| ≥ p90 | 1.49(1.10, 2.03) | 1.48(1.08, 2.04) | 1.51(1.09, 2.07) | 1.49(1.10, 2.03) | 1.52(1.10, 2.09) | 1.51(1.11, 2.05) | 1.53(1.12, 2.09) | 1.48(1.08, 2.04) | 1.51(1.09, 2.07) |
| PTrend | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| R-Square | 0.1218 | 0.1074 | 0.1098 | 0.1138 | 0.1075 | 0.1103 | 0.1226 | 0.1122 | 0.1100 |

[a]Adjusted for child's age, child's gender, child's ethnicity, duration of breastfeeding, mother's education level, frequency of daycare attendance, number of meals per day and the season of blood collection; [b]Percentiles of cumulative water lead exposure index (in µg of Pb/kg of body weight); [c]scenario assuming that children consume 80% of stagnant water and 20% of flushed water.

**Table S3:**

| Study | Date of study | Place of study | Children's age (Sample size) | Available descriptive data for water lead concentrations | Available descriptive data for blood lead concentrations | Main result, models and fit statistics |
|---|---|---|---|---|---|---|
| **Cross-sectional studies** | | | | | | |
| Levallois et al. 2014 | Sept 2009 – March 2010 | Montreal, QC (Canada) | 1 – 5 years (n=306) | GM (95% CI): 1.60 (1.40, 1.84) µg/L | GM (95%CI) : 1.35 (1.27, 1.43) µg/dL | Statistically significant positive association between water lead and BPb<br>No fit statistics reported |
| Lanphear et al. 1998 | August 29 – November 20, 1993 | Rochester, NY (USA) | 12 – 31 months (n=183) | GM : 0.0009 µg/g<br>GSD : 0.012 µg/g<br>Range : 0.0005 – 0.16 µg/g | GM: 6.2 µg/dL<br>GSD : 5.2 µg/dL<br>Range : 1.3 – 32.0 µg/dL | Positive, but borderline association (p=0.0618) between water lead and BPb : Slope = 0.0664 (SD : 0.035)<br>$R^2$=0.023 |
| Oulhote et al. 2013 | Sept 2008 – April 2009 | France | 6 – 84 months (n=484) | Range : < 1 – 74 µg/L | GM (95%CI): 14.0 (12.7, 15.0) µg/dL<br>Range : 0.26 – 30.8 µg/dL | BPb increase by 70% when lead in tap water increased from 1 to 25 g/L<br>No fit statistics reported |
| Gasana et al. 2006 | NA | Miami, FL (USA) | < 6 years (n=75) | Mean (SD) : 4.53 (18.09) µg/L for first-draw; 1.46 (2.33) µg/L for flushed samples (30 seconds of flushing) | Mean (SD): 3.41 (1.85) µg/dL<br>Median : 3.00 µg/dL | Spearman's correlation coefficient revealed no association between water lead and BPb (rho=0.03, p=0.81 for flushed water; rho=0.005, p=0.97 for first-draw water) |

| Study | Date of study | Place of study | Children's age (Sample size) | Available descriptive data for water lead concentrations | Available descriptive data for blood lead concentrations | Main result, models and fit statistics |
|---|---|---|---|---|---|---|
| **Cross-sectional studies** | | | | | | |
| Morse et al. 1979 | May 1977 | Bennington, VY (USA) | 1 – 12 years (n=192) | Weighted mean : 0.07 mg/L | Range : 7 – 43 µg/dL<br>Mean : 16.1 µg/dL | No correlation between water lead and BPb : |
| Our study | Sept 2009 – Sept 2011 | Montreal, QC (Canada) | 1 – 5 years (n=298) | Flushed water :<br>GM (95%CI) : 0.89 (0.06 – 12.52) µg/L<br>Stagnant water :<br>GM (95%CI) : 2.21 (0.14 – 35.27) µg/L | GM (95% CI) : 1.34 (0.50, 3.61) µg/dL | Positive association between water lead levels and Ln(BPb) (Adjusted slope : 1.06, $p<0.0001$), $R^2=0.08$<br>Positive association between cumulative water lead index and ln(BPb) (Adjusted slope : 0.10, $p<0.0001$), $R^2=0.12$ |
| **Follow-up studies** | | | | | | |
| Rabinowitz et al. 1985 | April 1979 – April 1981 | Boston, MA (USA) | From 1 to 24 months (n=232) | Weighted mean (SD) : 5.0 (0.9) µg/L | Mean (SD) of postnatal BPb: 7.0 (5.1) µg/dL | No correlation between water lead and BPb (Spearman's correlation coefficient between 0.00 and 0.14 depending on child's age) |
| Lanphear et al. 2002 | | Rochester, NY (USA) | From 6 to 24 months (n=249) | No reported | GM (95%CI) : 2.9 (2.7, 3.1) µg/dL at baseline; 7.5 (7.0, 8.2) µg/dL at 24 months | Positive and statistically significant association between water lead and BPb ($p<0.001$)<br>No fit statistics reported |

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